

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)  
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference TJ0402-PCT	<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/JP2004/008516	International filing date ( <i>day/month/year</i> ) 10.06.2004	Priority date ( <i>day/month/year</i> ) 11.07.2003	
International Patent Classification (IPC) or national classification and IPC H01L29/739			
<p>Applicant <b>TOYOTA JIDOSHA KABUSHIKI KAISHA</b></p>			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of 3 sheets, as follows:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</li> <li><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</li> </ul> <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the opinion</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>			
Date of submission of the demand 02.05.2005	Date of completion of this report 30.09.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Franche, V Telephone No. +31 70 340-4998		

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/JP2004/008516

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
    - international search (under Rules 12.3 and 23.1(b))
    - publication of the international application (under Rule 12.4)
    - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

### Description, Pages

1-22 as originally filed

### Claims, Numbers

2 as originally filed  
1, 3-6 received on 02.05.2005 with letter of 28.04.2005

### Drawings, Sheets

1/11-11/11 as originally filed

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3.  The amendments have resulted in the cancellation of:
    - the description, pages
    - the claims, Nos.
    - the drawings, sheets/figs
    - the sequence listing (*specify*):
    - any table(s) related to sequence listing (*specify*):
  4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
    - the description, pages
    - the claims, Nos. 1,5
    - the drawings, sheets/figs
    - the sequence listing (*specify*):
    - any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/JP2004/008516

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes:	Claims	1-6
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-6
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-6
	No:	Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/JP2004/008516

**Re Item I**

**Basis of the report**

The amendments filed with the letter dated 28.04.2005 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following.

Amendment in claims 1 and 5: "a drift region of n-type semiconductor provided below the active device", although it is written in page 2, lines 1-2: "beneath the p body region, n drift region is provided". Because the active device might not be the body region, this amendment goes beyond the application as filed.

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: US-B1-6 452 228 (HARA KUNIHIKO ET AL) 17 September 2002 (2002-09-17)

D2: US-B1-6 271 562 (GRAF HEIMO ET AL) 7 August 2001 (2001-08-07)

2. The closest prior art for claims 1-4 is seen as document D1 which discloses a vertical power MOSFET which differs from the invention in that in the invention:

- a part of the boundary of the source electrode with the insulation layer is in contact with a p-type region;
- a p-type region contacts the drain electrode.

The subject-matter of claims 1-4 is therefore new in the sense of Article 33(2) PCT.

The closest prior art for claims 5 and 6 is seen as document D2 which describes an insulated gate bipolar transistor which differs from the invention in that in the invention a part of the boundary of the source electrode with the insulation layer is in contact with a p-type region.

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.  
PCT/JP2004/008516

The subject-matter of claims 5 and 6 is therefore new in the sense of Article 33(2) PCT.

As there is no indication in any of the prior art references of an insulated gate bipolar transistor whose boundary of the source electrode with the insulation layer has a part in contact with a p-type region, the subject-matter of claims 1-6 is inventive in the sense of Article 33(3) PCT.

**Re Item VIII**

**Certain observations on the international application**

1. The application does not meet the requirements of Article 6 PCT, because claims 1 and 5 are not clear.
  - 1.1 It is written in claim 1: "a collector region of p-type semiconductor provided contacting and below the drift region". However, it is not clear what the collector is contacting.
  - 1.2 It is written in claims 1 and 5: "an end portion of conducting portion of the active device to the contact electrode". Nevertheless, it is not clear what "an end portion [...] to the contact electrode" is.
  - 1.3 The expression "marginal corner" is not clear in claim 1. Indeed, the difference between a "normal" corner and a "marginal" corner is not clear.
2. Claims 1 and 5 are not supported by the description as required by Article 6 PCT, as their scope is broader than justified by the description and drawings. Indeed, no gate electrode is claimed, although it is clear from the description that two gate electrodes are provided (see figure 20 and page 2, line 10).
3. The feature "collector region" in claims 1 and 5 is not clear because if the feature is intended to specify that the device is a bipolar transistor, then a bipolar transistor

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/JP2004/008516

should be claimed.

## CLAIMS

1. (Amended) A semiconductor device comprising:

an active device provided in a semiconductor substrate facing its principal plane,

5 a contact electrode provided outside of the semiconductor substrate conducting with the active device,

a drift region of N-type semiconductor provided below the active device, and

10 a collector region of P-type semiconductor provided contacting and below the drift region,

wherein an end portion of conducting portion of the active device to the contact electrode is composed with P-type semiconductor, and a marginal corner of the end portion on the P-type region of the active device is formed with a curved line or with 15 an obtuse angle.

2. (Unchanged) A semiconductor device of claim 1,

wherein a plurality of active devices are discretely arranged in the semiconductor substrate, and each active device has a conducting portion to a contact electrode, and

20 a corner portion of a conducting portion of an active device positioned at the end and at opposite side to another active device is formed with a curved line or with an obtuse angle.

3. (Amended) A semiconductor device of claim 1,

wherein the shape of conducting portion of the active device 25 to the contact electrode is formed in a broader width in an end portion than in the central portion.

4. (Amended) A semiconductor device of claim 3,

wherein a plurality of active devices are discretely arranged in the semiconductor substrate, and each active device has a conducting portion to a contact electrode,

5 an end portion of a conducting portion of an active device positioned at an end and at opposite side of another active device is formed broader than the central portion of the conducting portion, and

a corner portion of the end portion is formed with a curved line or with an obtuse angle.

10 5. (Amended) A semiconductor device comprising:

an active device provided in a semiconductor substrate facing its principal plane,

a contact electrode provided outside of the semiconductor substrate conducting with the active device,

15 a drift region of N-type semiconductor provided below the active device, and

a collector region of P-type semiconductor provided contacting and below the drift region,

20 wherein an end portion of conducting portion of the active device to the contact electrode is composed with P-type semiconductor, and impurity concentration within the conducting portion is lower at a corner portion of conducting portion than in other portion of it.

6. (Amended) A semiconductor device of claim 5,

25 wherein a plurality of active devices are discretely arranged in the semiconductor substrate, and each active device has a conducting portion to a contact electrode, and

24/1

a corner portion of a conducting portion of an active device positioned at an end and at opposite side of another active device is lower in impurity concentration than other portion of the  
5 conducting portion.

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